THE CONSOL/ALLEGHENY PILOT PLANT STUDY OF LOW-TEMPERATURE MERCURY CAPTURE WITH AN ELECTROSTATIC PRECIPITATOR

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CONCEPT

- Absorb Hg on particulate by cooling flue gas to 225-240 °F with air heater or water spray
- Collect particulate with ESP to remove Hg
- Protect against acid corrosion by introducing $Mg(OH)_2$ into flue gas upstream of heater

POTENTIAL BENEFITS OF TECHNOLOGY TO BE EXAMINED

- 70-90% Hg removal targeted
- Projected cost ($/lb Hg) is order of magnitude lower than carbon injection
- Suitable for retrofit or new plants
- Potentially suitable for the full range of coal types
- Effective SO_3 reduction
  - Visible plume mitigation
  - TRI reduction
  - SCR/SNCR benefits
  - Secondary fine particulate reduction
- Potential to improve heat rate by 2%
  - 2% reduction in NO_x, SO_2, CO, particulate and CO_2
  - ~ $600,000/y fuel cost savings for 600 MW plant

HOST PLANT
Allegheny Energy Mitchell Station

- Courtney, PA
- 288 MW Unit 3
- In service 1963
- Thiosorbic lime wet FGD, ESP, no SCR
- Fired with eastern bituminous coal

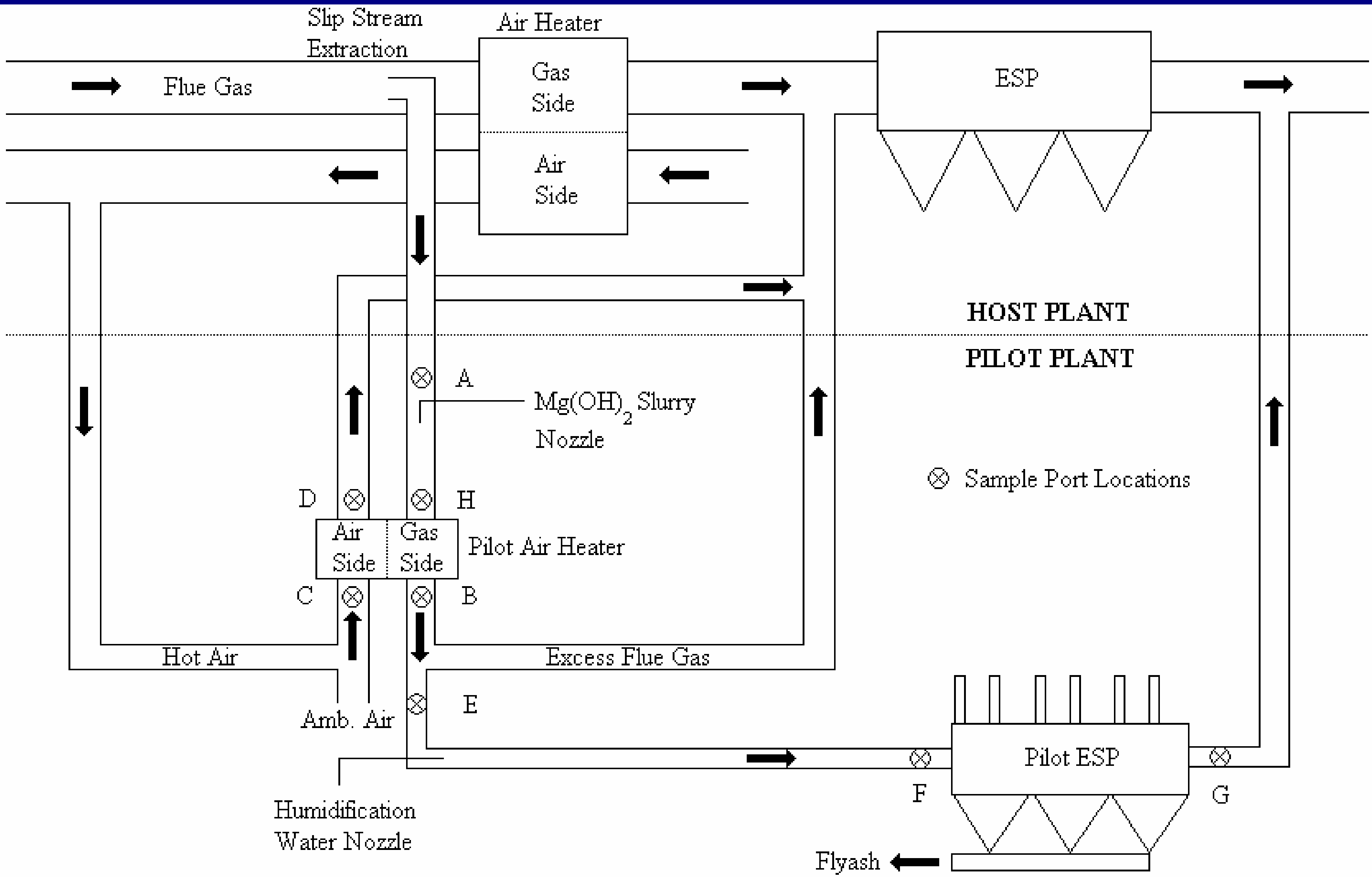
  S 3.0 - 4.8% Ash 9.3 – 15%

  Cl 0.05 - 0.09% Hg 0.09 - 0.13 ppm

  *Analyses on dry basis, except Hg as determined

ALLEGHENY MITCHELL STATION

PILOT PLANT PROCESS SCHEMATIC



PILOT AIR HEATER

PILOT ESP

EXPERIMENTAL PLAN

- Max. flue gas flowrate: 16,500 lb/h (1.7 MW)
- Mg/SO_3 molar ratio: 2/1 - 4/1
- Gas temperature at ESP inlet: 220 - 315 ºF
- Water spray cooling: on/off
- Gas sampling for Hg, particulate, SO_2, SO_3
- Speciate Hg at inlet/outlet of air heater and ESP
- Evaluate air heater and ESP performance and corrosion
- Evaluate stability of captured Hg

EFFECTIVENESS OF $Mg(OH)_2$ INJECTION FOR SO_3 CONTROL

	SO_3 Concentration, ppmv (Acid Dew point, °F) at Location		
$Mg:SO_3$ Mole Ratio	**Before Mg Injection**	**After Mg Injection, Before Air Heater**	**Air Heater Exhaust**
None	12.5 (274)	-	2.1 (237)
1.9/1	31.4 (287)	6.8 (256)	1.2 (230)
4.0/1	32.5 (288)	1.8 (236)	0.7 (222)

MERCURY CAPTURE BY ESP

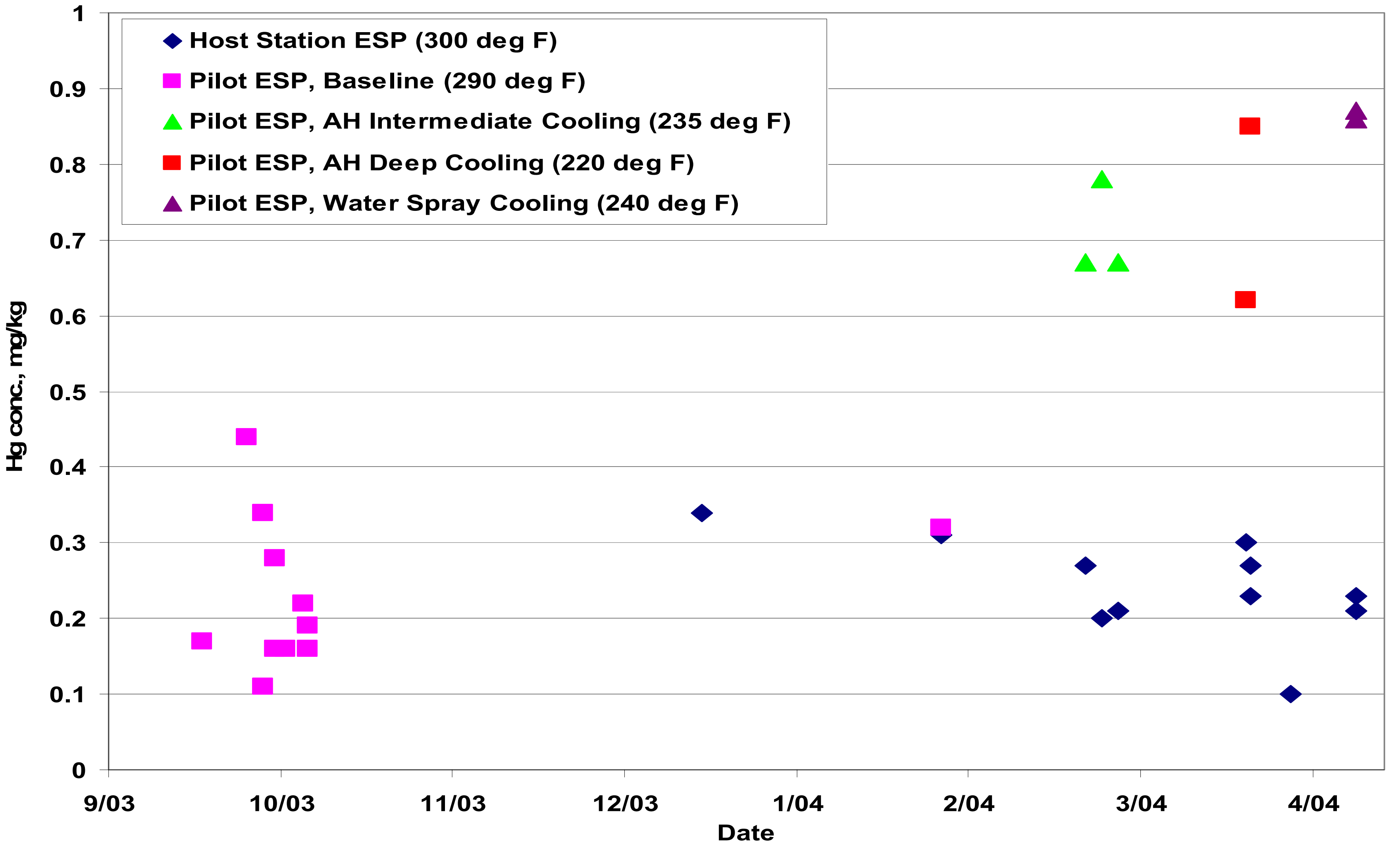
Test	$Mg:SO_3$ Mole Ratio	Temp., °F AH Exhaust	Temp., °F ESP Inlet	Hg Capture by ESP, mass % (each test)	Hg Capture by ESP, mass % avg. ± std. dev. (best values)
Baseline	0/1	320	290	9* / 14 / 39	26 ± 18
$Mg(OH)_2$, AH Cooling	1.9/1	250	235	40 / 31 / 29	34 ± 6
$Mg(OH)_2$, AH Cooling	3.5/1	234	220	48 / 35 / 83*	42 ± 9
$Mg(OH)_2$, WS Cooling	3.4/1	312	240	17* / 48 / 50	49 ± 1

*Poor/no Hg mass balance, not in average

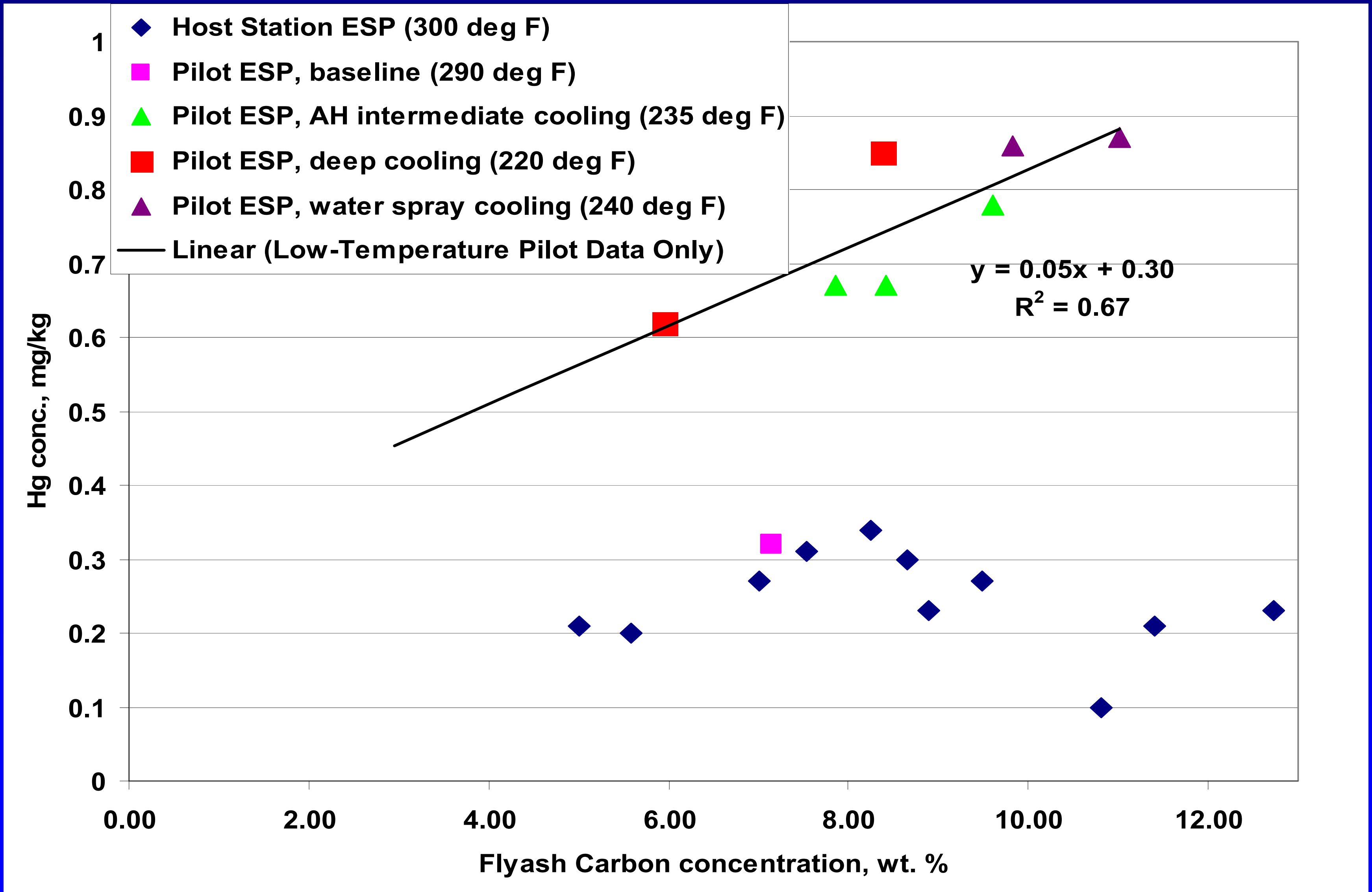
LOSS OF MERCURY ACROSS AIR HEATER

- Two tests at baseline conditions: no $Mg(OH)_2$, 315^oF
- 39% and 12% mercury lost across air heater
- We presume it recycles with heated air, similarly to SO_3

MERCURY IN FLYASH



MERCURY vs CARBON IN FLYASH



HG SPECIATION AT BASELINE OPERATING CONDITIONS

No $Mg(OH)_2$, 290°F (1/29/04)

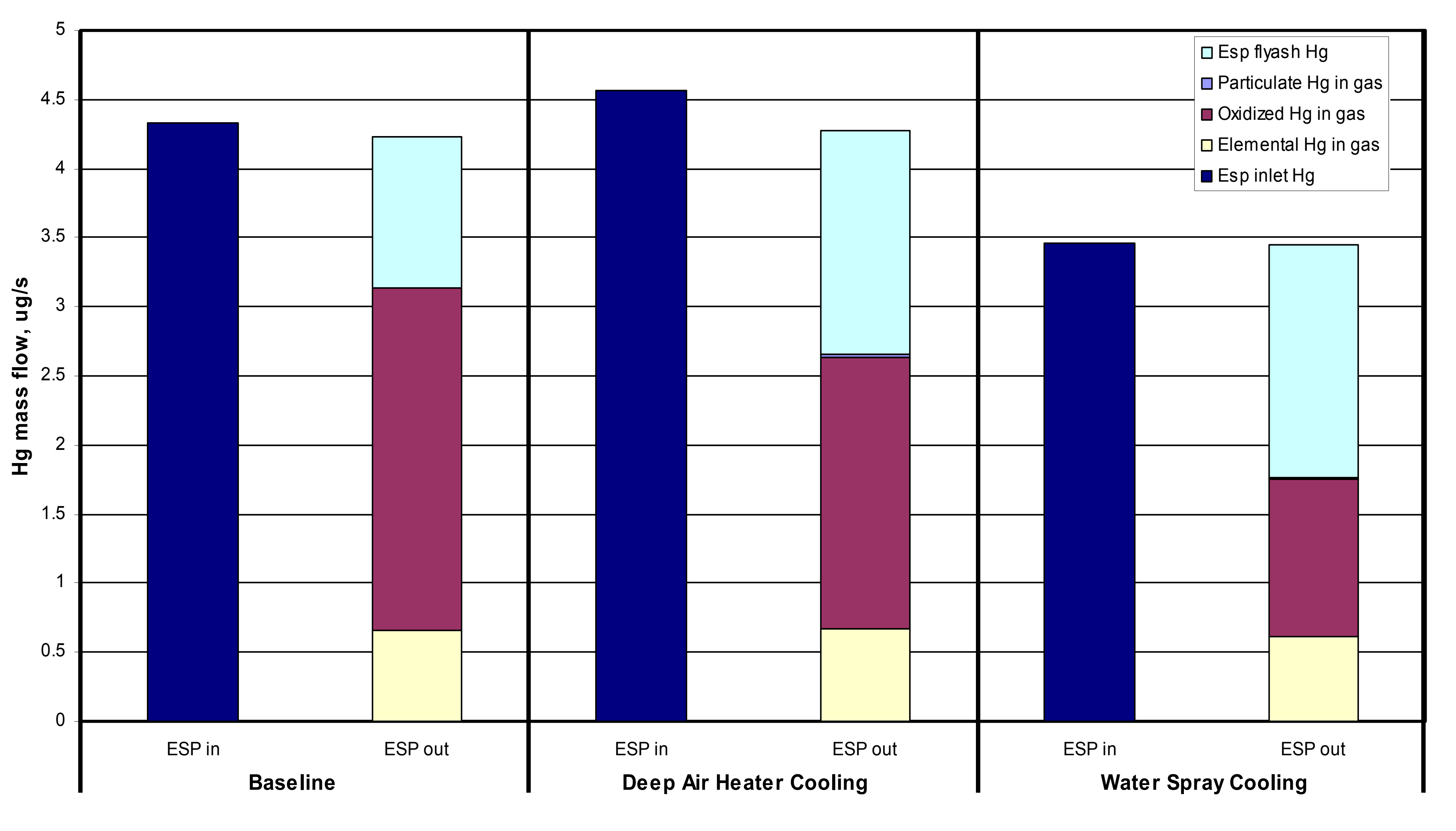
	Mass Flow Rates, μg/s at Location		
	ESP inlet	**ESP outlet**	**% Change**
Hg^o	0.55	0.70	27
Hg^{++}	2.2	2. 7	19
Hg^{part}	1.1	0.0	-100
Hg^{tot}	3.9	3.4	-13
Hg in flyash	-	0.99	NA
Sum	3.9	4.4	12

HG SPECIATION PROBLEMS AT OPERATING CONDITIONS

3.5/1 $Mg(OH)_2$, AH to 220°F (3/24/04)

	Mass Flow Rates, μg/s at Location		
	ESP Inlet	ESP Outlet	% Change
Hg^o	0.16	0.74	363
Hg^{++}	0.68	1.6	131
Hg^{part}	3.6	0.02	-99
Hg^{tot}	4.5	2.3	-48
Hg in flyash	-	1.5	NA
Sum	4.5	3.8	-15

MERCURY SPECIATION AT ESP OUTLET



PRINCIPAL INTERIM CONCLUSIONS

- $Mg(OH)_2$ slurry injection is effective for removal of SO_3
- Mercury removal sensitive to temperature
- Mercury removal may be sensitive to carbon content of fly ash
- Baseline conditions give about 25% mercury removal
- Near 50% ESP mercury removal demonstrated with cooling via air heater or water spray
- Emissions of elemental mercury are about the same at operating conditions as at baseline conditions

ADDITIONAL INTERIM CONCLUSIONS

- Ontario Hydro method appears to suffer problems with high-dust streams at temperatures of $\leq 250^{o}F$
- Some mercury lost in air heater; we presume it recycles with heated air, similarly to SO_3
- No increase in pilot air heater ΔP after 84 h total operation with sorbent injection
- Pilot ESP has performed satisfactorily with $Mg(OH)_2$ injection at reduced temperature

PROJECT PLANS AS OF JULY 14, 2004

- Long-term testing - rest of 2004
- Evaluation of air heater and ESP performance and corrosion
- Evaluation of mercury stability in flyash
- Project completion 3/05

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